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ABSTRACT

This report provides a complete guide to the stand alone mode operation of the reliability and maintenance (R&M) model, which was developed to facilitate the performance of design versus cost trade-offs within the digital avionics information system (DAIS) acquisition process. The features and structure of the model, its input data requirements, its logical operations, and its outputs are described; and instructions and format for preparing input data and for selecting output options are provided with sample output reports for each option that can be selected. Appendices include descriptions of input data elements and potential error messages, and a listing of acronyms used. (Author/CMV)

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AFHRL-TR-78-2(II)

AIR FORCE HUMAN RESOURCES LABORATORY

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DIGITAL AVIONICS INFORMATION SYSTEM (DAIS): RELIABILITY AND MAINTAINABILITY MODEL USERS GUIDE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The digital avionics information system (DAIS) life cycle cost (LCC) study provides the Air Force with an enhanced in-house capability to incorporate LCC considerations during all stages of the system acquisition process. This report documents a reliability and maintainability (R&M) model developed in the study and also serves as a users manual. The R&M model, a training model, and a cost model comprise the DAIS LCC impact model (LCCIM) designed for use in LCC analysis of avionics systems. In this context, its primary function is to manipulate input data banks to produce intermediate products, figures of merit, and outputs required by the training and cost models. When used in a stand-alone mode, the R&M model provides a means for analyzing the R&M impact of changes in system design and maintenance concepts on system support requirements.

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The input data banks contain values for the R&M parameters of avionics hardware configurations, i.e., maintenance action rate, maintenance task event time, task event probability of occurrence, manpower required for each task, skill level requirements, and support equipment (SE) required for each task. The R&M model employs a figure of merit concept to aggregate the values for these R&M parameters to produce manhour and SE requirement estimates. These are point estimates; however, they can be used to (a) make comparisons on a total system, subsystem, or line replaceable unit (LRU) basis, and (b) identify "high drivers" or problem areas in terms of resource requirements. In addition, the R&M model can be used to conduct sensitivity and trade-off analyses in terms of resource requirements after it has identified high driver items. It can perturb combinations of R&M parameters to determine sensitivities. Thus, alternatives for achieving a reduction in resource requirements can be assessed by selectively altering input data and observing the model's outputs indicating the resultant changes in resource requirements.

This document is intended to guide the user of the R&M model. It describes the features of the model, its logical operations, its input data requirements, and its output reports. It also provides a program listing, instructions for preparing input data, and guidance for interpreting and using output reports.

SUMMARY

This report is Volume II of AFHRL-TR-78-2 which describes a reliability and maintainability (R&M) model developed to facilitate the performance of design vs. cost trade-offs within the systems acquisition process. The model can provide timely visibility to relationships between system design and support requirements and a means of using them to avoid unnecessarily high system operation and maintenance cost. Stand-alone operation permits the user to assess potential impacts of design reliability factors on system support factors and operational availability. However, the R&M model was also designed to function as part of a modeling system which includes a training requirements analysis model and a system cost model. Joint operation provides the capability of translating the design impact assessments into estimates of the consequent cost of system operation and maintenance and, ultimately, that of performing design vs. cost trade-offs.

The R&M model operates in conjunction with a computerized data bank containing historical reliability and maintenance data gathered from operational systems. This data is made relevant to new systems by factoring the historical data on the basis of system/subsystem comparability analyses. Inputs to the R&M model include: the frequency of maintenance actions by subsystem and line replaceable unit (LRU) for both aircraft and support equipment (SE); and data concerning the task events within each maintenance action such as type, probability of occurrence, time to complete, manpower type and skill requirements, and SE requirements. The model uses these inputs to compute the manhour resources, SE, and spares consumed, by task event, to satisfy the maintenance requirements of each subsystem and its LRUs for both flight line and shop actions. Outputs are displayed in matrix format.

Capable of extremely rapid operation, the R&M model affords the user a powerful tool for answering a multitude of "what if" questions concerning the implications of system design on support requirements. Its speed facilitates iterative application and should promote trade-off analyses early in the design process when cost avoidance actions are most effective. This operational speed stems from the fact that, unlike simulation models sometimes used in this type of analysis, the R&M model does not attempt to account for peak loads, saturations, queues, or other nonlinear constraints that exist in the actual maintenance environment. Rather, it is an average value model which uses estimates of maintenance task and equipment R&M factor values to compute the average expected values for

resource requirements. Additionally, a figure of merit concept is employed to aggregate the detailed data outputs and generate structured data products which allow comparisons to be made and high resource consumers to be identified on either an LRU, subsystem, or system basis. An example of such a figure of merit is maintenance manhours per 1000 flight hours.

Apart from its ability to facilitate sensitivity and trade-off analyses, the R&M model can aid the user in determining the most acceptable means of avoiding undesirable potential impacts which it has identified. By comparing alternative cause and result situations, trade-off analyses can be employed in a more investigative manner. This entails an iterative model application to determine the differential effects on projected support resource requirements obtainable by changing combinations of R&M parameters. An example of such a trade-off might be the cost to achieve an increased subsystem reliability versus that to obtain a reduced flight line troubleshooting time. The user can determine the various combinations of reliability improvement and reduced flight line troubleshooting time to achieve a specified reduction in support resource requirements for that subsystem. These values would be inputted to training and cost portions of the modeling system to assist in evaluating alternatives on a total cost of ownership basis.

The initial application of the R&M model is directed at the determination of the potential impacts of the digital avionics information system (DAIS) on system support personnel requirements and life cycle cost. Results will be contained in a later technical report within the series of which this is a member. The model is, however, applicable in the development of almost any new system as well as the evaluation of existing systems.

This volume provides a complete guide to the operation of the R&M model in the stand alone mode. It describes the features and structure of the model, its input data requirements, its logical operations, and its output reports. It provides instructions and the format for preparing input data and for selecting output options. Sample output reports are also provided for each option that can be selected. A listing and description of potential error messages are included in the appendix, as well as a listing of the computer program.

PREFACE

This report is one of a series of technical reports, models, and data banks produced under contract no. F33615-75-C-5218, "DAIS Life Cycle Costing Study." Results of this study, in combination with the present Air Force capabilities provide the means to assess the life cycle cost impact of the operational implementation of the Digital Avionics Information System (DAIS).

The study was directed by the Advanced Systems Division, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, Ohio, and is documented under Work Unit 20510001, "DAIS Life Cycle Costing Study." It was performed under Air Force Avionics Laboratory Program Element 63243F, "Digital Avionics Information System," as Project 2051. Project 2051, "Impact of the DAIS on Life Cycle Costs," is jointly sponsored by the Air Force Human Resources Laboratory, the Air Force Avionics Laboratory, and Air Force Logistics Command. Contract funds were provided by the Air Force Avionics Laboratory. The DAIS Program Manager is Lt. Col. Robert A. Dessert. The Air Force Human Resources Laboratory Project Scientist is Mr. H. Anthony Baran. The Air Force Logistics Command project officer is Capt. Ronald Hahn. The latter two are DAIS deputy directors. The Contractor Program Manager is Mr. John C. Goclowski.

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DIGITAL AVIONICS INFORMATION SYSTEM (DAIS): RELIABILITY AND MAINTAINABILITY MODEL USERS GUIDE

I. INTRODUCTION

The reliability and maintainability (R&M) model, in conjunction with a cost model and a training model, make up a life cycle cost impact model (LCCIM). The R&M model is an analytical type batch process model that computes unique outputs based on a given set of values for R&M input variables. These inputs pertain to avionics subsystems and their line replaceable units (LRU). The principal data input elements consist of average times to complete maintenance task events, the associated probabilities of occurrence of those events, and the frequency of the equipment maintenance. Other R&M inputs include the type of task event; the number, type, and skill level of each manpower specialty needed to perform the task event; and the support equipment required.

The computed outputs of this model are "expected values" since they are based on average input values rather than on peak demands, or other constraints, such as queuing or the nonlinearities inherent in a "real world" type of simulation model. These outputs are principally measures of the maintenance manhour resource requirements which may be expected to result under a given set of conditions. These conditions are determined by system variables such as equipment configuration, equipment design, and/or the system support maintenance concept. The particulars of these conditions are made available to the model in terms of the R&M input variables previously described.

Main Features

The R&M model is available in Fortran IV language for both the Honeywell H-6000 and Control Data Corporation CDC-6600 Cyber 74 computers. It is characterized by the following:

- Unlimited flexibility in the representation of the avionics equipment structure
- Similarly structured output reports for all output parameters
- Selection for analysis of a single subsystem, all subsystems, or a categorical group of subsystems
- Automatic output of short summary reports, optional output of complete reports.

General Description

The primary purpose of the R&M model is to provide data input to the LCCIM cost model and training model. However, in a stand-alone operation, this model provides a means for analyzing the R&M impact of various avionics design and support concept parameters. It employs a figure of merit (FOM) concept to aggregate the data and then to make comparisons of resources required on a total system, subsystem, or LRU basis and to identify "high drivers" or problem areas of high resource requirements. FOM analyses within the model may address, for example, maintenance manhours per 1000 flight hours (measures maintenance manhour resource requirements) and service availability (measures the impact of maintenance on operational availability). The basic parameters used to calculate the FOMs for each subsystem, broken out for each shop and flight line maintenance task event, are:

- Probability of occurrence
- Average time to complete the event
- Air Force specialty and skill level
- Support equipment

The maintenance action rate for each subsystem is input as mean flight hours between maintenance actions.

By making reasonable variations in any of the foregoing input parameters, the model can be used to note the effect on the various outputs. In this way, the R&M model can be used to conduct sensitivity and trade-off analyses. Thus, after high driver items are identified in terms of resource requirements, combinations of R&M parameters can be perturbed to determine the system sensitivities. Alternatives for achieving reduction in the resources required can thus be identified.

Data Structure

The data represented in the R&M model are structured in matrix form permitting all outputs to be displayed in similar fashion. The data elements in each row of an output report convey information (such as mean time to repair (MTTR)) for each maintenance task event leading to a particular outcome that results from a maintenance action. The columns convey the same information for a selected maintenance task event.

A maintenance action is defined as any subsystem malfunction that results in a series of maintenance task events. These events are those principal tasks necessary to restore the subsystem to operational readiness and to accomplish any necessary repairs of removed LRUs. The maintenance task events consist of one or more maintenance functions or major tasks (e.g., adjust, align, calibrate, troubleshoot, inspect, operate, remove/install, repair, service, etc.). Each flight line maintenance task event and each shop maintenance task event are defined in Appendix A under FLIGHT LINE TASKS and SHOP TASKS, respectively. If further explanation of the terms maintenance action and maintenance event are desired, they are explained in detail in volume one of this report.

II. MODEL LOGIC

This section describes the computer program used to implement the R&M model. It will provide the analyst with an in-depth view of the workings of the program.

Model Input

Initially, data are read into computer storage from the R&M data base files. Detailed descriptions for each input data element contained on the records that constitute the base files are included in Appendix A. These data files are part of an integrated data bank. Verification of the input data for accuracy or completeness can only be made by a comparison of the input data with its raw data source. However, the program is capable of generating certain error messages. Appendix B provides a list of them. Other data problems will result in an immediate halt of the program, usually following a message from the computer system. The input card which caused this type of problem will normally be the last one displayed on the computer printout.

Calculations

The main body of the R&M model generates two matrices plus an additional matrix for each Air Force specialty code (AFSC) of interest. A support equipment (SE) maintenance requirements matrix is also generated. These matrices represent the following:

- MTTR - mean time to repair for each shop and flight line maintenance event is defined and calculated as follows: the probability of occurrence of the task event, given that

there is a failure, multiplied by the maintenance event task time. It should be noted that the maintenance event task time used as the input for this computation is the actual average time it takes to accomplish the event based on historical data; i.e., the input is the mean time to repair per task event without considering the probability of occurrence.

- MMH - maintenance manhours for each shop and flight line task event. This is calculated as MTTR multiplied by the total number of AFSCs required for the event.
- SE maintenance - for each shop test station a matrix is set up to give values for the MTTR, MMH, MMH/1000 FH, and MTTR/1000 FH consumed in test drawer and test station repair for each LRU tested. The ready time of the test station per 1000 operating hours of test time is also calculated in the model.
- For each AFSC designated for analysis, another matrix is set up that displays the MMH/1000 FH consumed for each LRU and subsystem that is maintained. These values are then multiplied by a constant cost factor to show the manhour cost per 1000 flight hours.

Once the single task event/single outcome elements of each matrix have been computed, the program totals across maintenance events (columns) and outcomes (rows) to complete the matrix. These matrices are intermediate products which are the basis for a series of user selected output options.

The flight line inherent availability (A) of each subsystem is also calculated within the model by dividing the mean flight hours between maintenance actions (MFHBMA) by the total of the MFHBMA and the flight line MTTR. This calculation can also be represented as:

$$A = \frac{1}{1 + (MTTR)(PMA)}$$

where $PMA = \frac{1}{MFHBMA}$,

or the probability of a maintenance action (PMA) per flight hour.

The service flight line availability for the avionics system is then calculated within the model as the product of all of the inherent subsystem availabilities.

Model Output

Subsystem inherent flight line availability is a mandatory output, as is the listing of the input data files which precedes it. All other outputs are user selected as described in Section IV.

Except for the MTTR and MMH matrices (including the MMH/1000 FH required for user selected AFSCs), the remainder of the output is calculated when selected. To display the MTTR as percent of total, each matrix element is divided by one one-hundredth of the total MTTR for that subsystem. MMH as a percent of total is computed in the same manner. MMH per 1000 flight hours (FH) is calculated by dividing each matrix element by one one-thousandth of the MFHBMA. Maintenance index (defined as the MTTR per 1000 FH) is each element of the MTTR matrix divided by one one-thousandth of the MFHBMA, also.

Most outputs can be summed over a group of subsystems for examination at a higher level of aggregation.

Program Flow Chart

The basic flow of execution of the R&M model is shown in Figure 1.

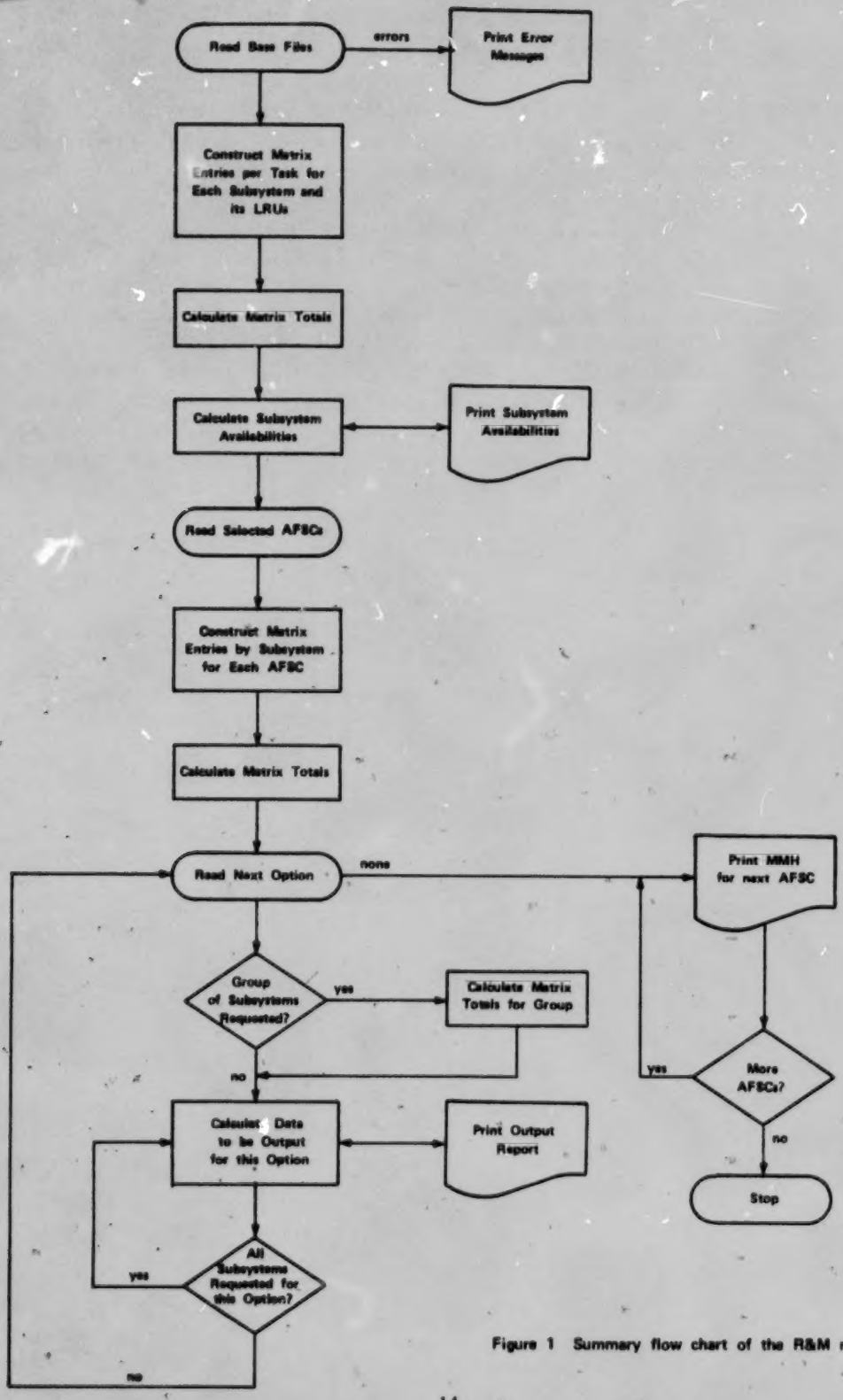

Figure 1 Summary flow chart of the R&M model

III. EXAMPLE RUN

Subsequent sections describe the input forms and output reports of the model. To facilitate this description, an example run has been constructed and is used to illustrate the ways in which the data are input to the model and results displayed on output reports.

The example run consists of an avionics system containing six subsysystems and 14 LRUs. The arrangement of these items in the equipment hierarchy structure for the system is shown in Figure 2. Dashed line boxes represent equipment not represented in the example run.

All of the input data for the example run are given in the sample input data in the next section. The sample data are generally similar to the type of data prepared for operational use of the model.

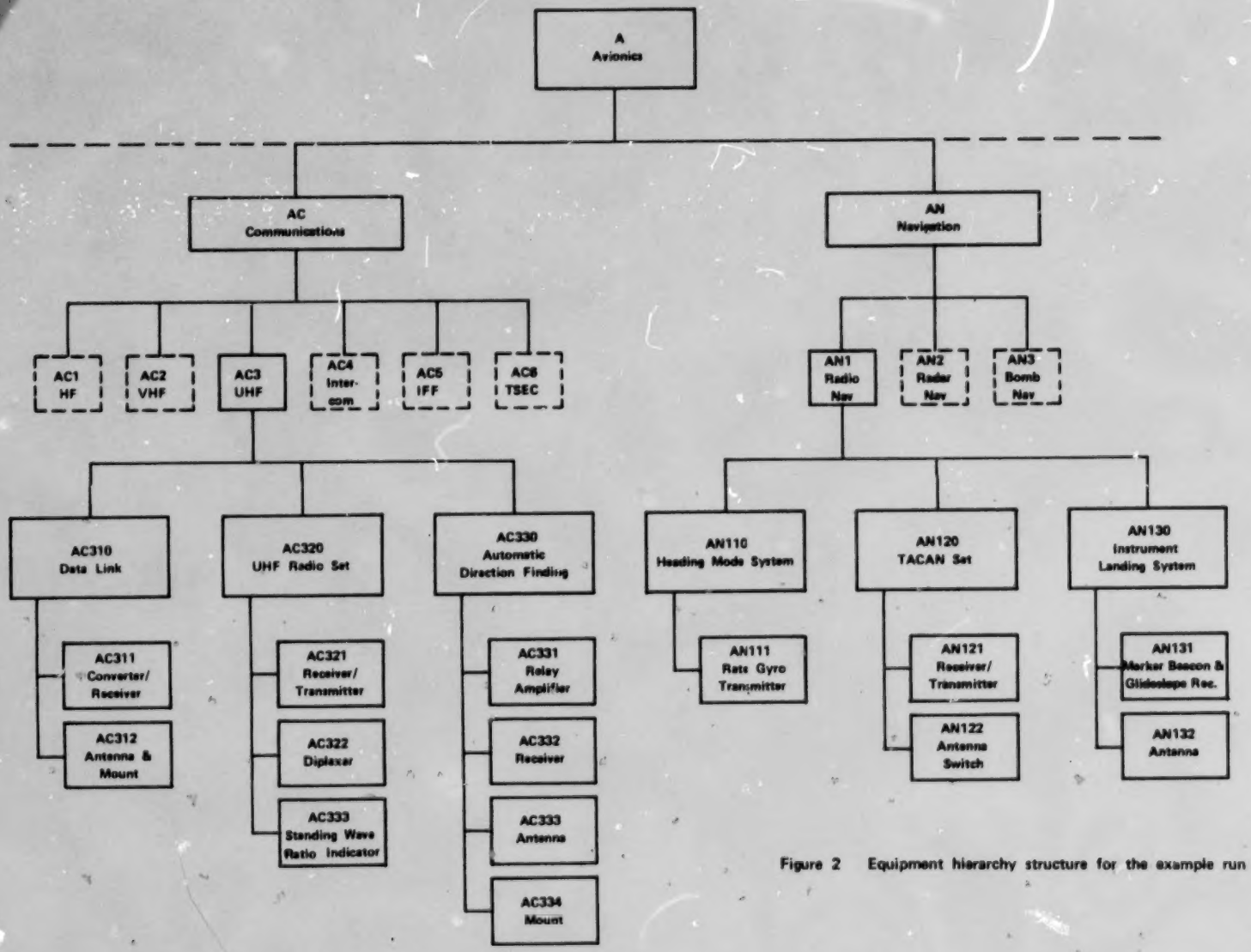

Figure 2 Equipment hierarchy structure for the example run

IV. INPUT FORMATS

Data File Formats

The operation of the R&M model requires that a variety of special input cards be prepared which precisely describe the equipment being analyzed and its logistics support system. There are 13 record card formats. Each contains a particular category of data. A detailed description of the input data elements contained in each field of the individual record cards is included in Appendix A.

The input record card formats, each of which is identified by a two-character code in columns 1 and 2, are described on the following pages. Tables which immediately follow the card type descriptions provide a listing of the data elements contained on each card along with their field format. Each of the tables is preceded by a figure illustrating the input data cards necessary for execution of the example run.

Two cards must precede the input deck. The first card contains the data base title. The second card must contain the number of subsystems to be described punched in columns 1 and 2. (In the example run, which contains six subsystems, a "06" is provided on the second card preceding the input deck.) Each card type must have at least one card for every subsystem/LRU that is input in the cross reference file. The present program allows a number of cards for subsystems and LRUs of 40 and 120, respectively.

Card Type CR - Cross Reference File

The first card type designates the equipment hierarchy structure. This structure is illustrated in Figure 2. The data used in this cross reference file is allocated to two cards noted as a -1 or -2 in column 12, the card sequence column. The second card is a continuation of the first and, when used, contains specific additional information.

CR card number 1 gives the equipment identification (ID) number, LRU weight in pounds, work unit code (WUC), quantity per aircraft (QPA), and the name of the subsystem or LRU. The subsystem CR card also gives the number of LRUs it contains, whereas the LRU CR card gives the number of SRUs that the LRU contains. Card number 2 contains the LRU national stock number (NSN), the AN/nomenclature of the subsystem and LRU, and the manufacturer's part number for the subsystem and LRU. There must be a #1 card for each subsystem and for each LRU, but a #2 card is not mandatory. As pertinent data required by the #2 card are available, they can be used to provide additional identification or reference information. Each card group begins with a subsystem card and is followed by the cards describing the LRUs which belong to it. The formats for CR cards 1 and 2 are shown in Tables 1a and 1b, respectively, and are further described in Appendix A.

A printout of the cards used for the example run are shown in Figure 3. The 06 in columns 1 and 2 of the second card is the "number of subsystems." Note that the same card format is used for both subsystems and LRUs.

```
DAIS THEORETICAL  RELIABILITY AND MAINTAINABILITY MODEL
06
CR  AC310 -1        63510  1 DATA LINK                                    2
CR  AC310 -2        63150                              AN/ASW- 25
CR  AC311 -1  11.8  63511  1 CONVERTER/RECEIVER                           8
CR  AC311 -2        63511                              CV-2230A/ASW-25
CR  AC312 -1   2.0  63515  1 MOUNT & ANTENNA                              1
CR  AC320 -1        63A00  1 UHF RADIO SET                                3
CR  AC320 -2        63A00                              AN/ARC- 51BX
CR  AC321 -1  27.7  63AA0  1 RECEIVER/TRANSMITTER (UHF)                   9
CR  AC321 -2        63AA0    5821-00-134-6239          RT-742B/ARC-51BX
CR  AC322 -1   1.0  63AE0  1 DIPLEXER                                     2
CR  AC323 -1   1.1  63AL0  1 STANDING WAVE RATIO INDICATOR               1
CR  AC323 -2        63AL0    5821-00-978-7867          ID-1003/ARC
CR  AC330 -1        63B00  1 AUTOMATIC DIRECTION FINDING SET - UHF        4
CR  AC330 -2        63B00                              AN/ARA- 50
CR  AC331 -1   5.4  63BA0  1 RELAY AMPLIFIER                             2
CR  AC331 -2        63BA0    5826-00-059-2726          AM-3624/ARA-50
CR  AC332 -1  10.0  63BB0  1 ANTENNA                                      1
CR  AC332 -2        63BB0    5826-00-849-0055          AS-909/ARA-48
CR  AC333 -1   8.0  63BC0  1 RECEIVER                                     7
CR  AC333 -2        63BC0    5821-00-999-4590-MA       R-1286/ARR-69
CR  AC334 -1   1.1  63BF0  1 MOUNT                                        1
CR  AN110 -1        71A00  1 HEADING MODE SYSTEM                          1
CR  AN111 -1   4.0  71AD0  1 RATE GYRO TRANSMITTER                        1
CR  AN120 -1        71B00  1 TACAN SET                                    2
CR  AN120 -2        71B00                              AN/ARN- 52
CR  AN121 -1  43.3  71BA0  1 RECEIVER/TRANSMITTER (TACAN)                 8
CR  AN121 -2        71BA0    5826-00-884-0914          RT-893/ARN-52
CR  AN122 -1   2.3  71BB0  1 ANTENNA SWITCH                               1
CR  AN130 -1        71C00  1 INSTRUMENT LANDING SYSTEM                    2
CR  AN130 -2        71C00                              AN/ARN- 58A
CR  AN131 -1   8.6  71CA0  1 RADIO MARKER BEACON & GLIDESLOPE REC         6
CR  AN131 -2        71CA     5826-00-226-6030          R-844A/ARN-58A
CR  AN132 -1   4.0  71CC0  1 ANTENNA                                      1
CR  AN132 -2
```

Figure 3. Printout of CR cards with "title" card and "number of subsystems" card for the example run

Table 1a

Field Format of Data Elements Cross Reference File – Card No. 1

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type - CR	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Organizational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit (LRU)	1	X	F	–
10	Shop Replaceable Unit (SRU)	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence – 1	1	N	F	–
13	Blank	1	–	–	–
14 - 18	LRU Weight--in lbs (col. 17 is a decimal)	5	N	R	1
19	Blank	1	–	–	–
20 - 24	Work Unit Code	5	X	F	–
25	Blank	1	–	–	–
26 - 27	Quantity per Aircraft (QPA)	2	N	R	–
28	Blank	1	–	–	–
29 - 68	Equipment Name	40	A	L	–
69 - 74	Blank	6	–	–	–
75 - 76	No. of LRUs in the Subsystem or SRUs per LRU	2	N	R	–
77 - 80	Blank	4	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Table 1b

Cross Reference File – Card No. 2

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type CR	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Organizational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	N	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence – 2	1	N	F	–
13 - 19	Blank	7	–	–	–
20 - 24	Work Unit Code	5	X	F	–
25	Blank	1	–	–	–
26 - 27	Dual Cognizance Code	2	X	F	–
28	Material Control Code	1	X	F	–
29	Dash	1	X	F	–
30 - 33	Federal Supply Classification (NSN)	4	N	F	–
34	Dash	1	X	F	–
35 - 36	Country Code (NSN)	2	N	F	–
37	Blank	1	–	–	–
38 - 40	Federal Item ID No. (NSN)	3	N	F	–
41	Dash	1	X	F	–
42 - 45	Federal Item ID No. cont. (NSN)	4	N	F	–
46	Dash (only when suffix is added)	1	X	F	–
47 - 48	Special Material ID Code (NSN Suffix)	2	A	F	–
49	Blank	1	–	–	–
50 - 52†	AN/	3	X	F	–
53 - 55	AN/No. Alpha Code	3	A	F	–
56	Dash	1	X	F	–
57 - 59	AN/No. Numeric Code	3	N	R	–
60 - 61	AN/No. Alpha Suffix Code	2	A	L	–
62 - 64	Blank	1	–	–	–
65 - 80	Manufacturers Stock Number	15	N	R	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

† for LRU part number left justify from column 50

Card Type SF - Support Equipment - Flight Line File

The flight line support equipment cards (SF) identify for the model what special support equipment is needed on the flight line to perform each maintenance task event. One or more SF cards must be supplied for each subsystem, in the format specified in Table 2 and further described in Appendix A.

These cards may be in any order, but placing them in the same order as the CR cards is recommended for more efficient program operation and for ease of editing. If more than one item of support equipment is required for any flight line task event(s) for a particular subsystem, an additional card is used, identifying the additional support equipment in the same fields of the second card. Columns 1-11 of the two cards should be the same, with column 12 set at "2" for the second card and "3" for a third. Only the first card of the group requires an entry in columns 56-57, which conveys the total cards for the equipment. If there is only one card, a zero or a one or a blank may be used. The current version of the program allows a maximum of three pieces of support equipment per maintenance event. The cards used for the example run are listed in Figure 4.

	ID#		A	T	CND	R	M	VR	VM
SF	AC310	-1	D60	D60	D60	D60	D60	D60	D60
SF	AC320	-1	D60	D60	D60	D60	D60	D60	D60
SF	AC330	-1	D60	D60	D60	D60	D60	D60	D60
SF	AN110	-1	D60	D60	D60	D60	D60	D60	D60
SF	AN120	-1	D60	D60	D60	D60	D60	D60	D60
SF	AN130	-1	D60	D60	D60	D60	D60	D60	D60

Figure 4. Printout of SF cards for the example run

Table 2

Support Equipment – Flight Line File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – SF	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13	Blank	1	–	–	–
14 - 18	(A) Set Up Support Equipment (SE)	5	N	L	–
19	Blank	1	–	–	–
20 - 24	(T) Troubleshooting SE	5	N	L	–
25	Blank	1	–	–	–
26 - 30	(C) Cannot Duplicate Discrepancy SE	5	N	L	–
31	Blank	1	–	–	–
32 - 36	(R) SE to Remove & Replace (R&R)	5	N	L	–
37	Blank	1	–	–	–
38 - 42	(M) On Aircraft (A/C) Maint. SE	5	N	L	–
43	Blank	1	–	–	–
44 - 48	(V_R) R&R Verification SE	5	N	L	–
49	Blank	11	–	–	–
50 - 54	(V_M) On A/C Maint. Verif. SE	5	N	L	–
55	Blank	1	–	–	–
56 - 57	Maximum No. of SE Per Task	2	N	R	–
58 - 80	Blank	23	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type LF - Air Force Specialty - Flight Line File

The flight line Air Force specialty (LF) cards identify the manpower by specialty type and skill level that is needed to accomplish each maintenance task event. One or more LF cards must be supplied for each subsystem and should be organized in the same order as the CR cards for more efficient program operation and ease of editing. The current version of the program allows assigning up to five Air Force specialty codes (AFSCs) per task event per equipment. Table 3 gives the card format which is further described in Appendix A. The cards for the example run are listed in Figure 5.

	ID#	A	T	CND	R	M	VR	VM	#
LF	AC310 -1	43171	32833	32853	32833	32853	32853	32853	2
LF	AC310 -2	42153					32833	32833	
LF	AC320 -1	43171	32833	32853	32833	32853	32853	32853	2
LF	AC320 -2	42153		32833		32833			
LF	AC330 -1	43171	32833	32853	32833	32853	32853	32853	2
LF	AC330 -2	42153		32833		32833	32833	32833	
LF	AN110 -1	43171	32831	32851	32831	32851	32851	32851	2
LF	AN110 -2	42153		32831		32831			
LF	AN120 -1	43171	32831	32851	32831	32851	32851	32851	2
LF	AN120 -2	42153		32831		32831			
LF	AN130 -1	43171	32831	32851	32831	32851	32851	32851	2
LF	AN130 -2	42153		32831		32831	32831	32831	

Figure 5. Printout of LF cards for the example run

Table 3

Air Force Specialty – Flight Line File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – LF	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft Sytem	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13	Blank	1	–	–	–
14 - 18	(A) AFSC to Set Up Support Equipment	5	N	F	–
19	Blank	1	–	–	–
20 - 24	(T) Troubleshooting AFSC	5	N	F	–
25	Blank	1	–	–	–
26 - 30	(C) Cannot Duplicate Discrepancy AFSC	5	N	F	–
31	Blank	1	–	–	–
32 - 36	(R) AFSC to Remove & Replace (R&R)	5	N	F	–
37	Blank	1	–	–	–
38 - 42	(M) On Aircraft (A/C) Maint. AFSC	5	N	F	–
43	Blank	1	–	–	–
44 - 48	(V_R) R&R Verification AFSC	5	N	F	–
49	Blank	1	–	–	–
50 - 54	(V_M) On A/C Maint. Verif. AFSC	5	N	F	–
55	Blank	1	–	–	–
56 - 57	Maximum No. of AFSCs Per Task	2	N	R	–
58 - 80	Blank	23	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type LS - Air Force Specialty - Shop File

The shop Air Force specialty (LS) cards, like the flight line LF cards, identify the manpower needed to perform the associated shop tasks. One or more LS cards must be supplied for each LRU accounted for by the CR cards. These cards may be in any order, but placing them in the same order as the CR cards is recommended for more efficient program operation and for ease of editing. The format is found in Table 4 and is further described in Appendix A. A printout of the cards used for the example run are listed in Figure 6.

	ID#	W	K	N	TD	TS	#
LS	AC311 -1	32850	32850	32850	3265A	3265A	2
LS	AC311 -2	32830			3263A	3263A	
LS	AC312 -1	32850		32850			2
LS	AC312 -2	32830					
LS	AC321 -1	32850	32850	32850	3265A	3265A	2
LS	AC321 -2	32830			3263A	3263A	
LS	AC322 -1	32850		32850	3265A	3265A	2
LS	AC322 -2				3263A	3263A	
LS	AC323 -1	32850		32850	3265A	3265A	2
LS	AC323 -2				3263A	3263A	
LS	AC331 -1	32850	32850		3265A	3265A	2
LS	AC331 -2	32830			3263A	3263A	
LS	AC332 -1	32850		32850	3265A	3265A	2
LS	AC332 -2	32830			3263A	3263A	
LS	AC333 -1	32850	32850		3265A	3265A	2
LS	AC333 -2	32830			3263A	3263A	
LS	AC334 -1	32850		32850			2
LS	AC334 -2	32830					
LS	AN111 -1			32651	3265B	3265B	2
LS	AN111 -2				3263B	3265B	
LS	AN121 -1	32850	32850	32850	3265A	3265A	2
LS	AN121 -2	32830			3263A	3263A	
LS	AN122 -1			32850	3265A	3265A	2
LS	AN122 -2				3263A	3263A	
LS	AN131 -1	32850	32850	32850	3265A	3265A	2
LS	AN131 -2	32830			3263A	3263A	
LS	AN132 -1			32850			1

Figure 6. Printout of LS cards for the example run

Table 4

Air Force Specialty – Shop File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type - LS	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Organizational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13 - 19	Blank	7	–	–	–
20 - 24	(W) Bench Check & Repair AFSC	5	N	F	–
25	Blank	1	–	–	–
26 - 30	(K) Bench Check & CND AFSC	5	N	F	–
31	Blank	1	–	–	–
32 - 36	(N) Bench Check & NRTS AFSC	5	N	F	–
37 - 39	Blank	13	–	–	–
50 - 54	(TD) Test Drawer Repair AFSC	5	N	F	–
55	Blank	1	–	–	–
56 - 60	(TS) Test Station Repair AFSC	5	N	F	–
61	Blank	1	–	–	–
62 - 63	Maximum No. of AFSCs Per Task	2	N	R	–
64 - 80	Blank	17	–	–	–

*A - alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type TS - Task Time - Shop File

The shop task time (TS) cards provide the model with the average time per worker that it takes to accomplish the associated task event. For each LRU, one card of type TS is required to input the shop task event times. These cards may be in any order, but placing them in the same order as the CR cards is recommended for more efficient program operation and for ease of editing. The card format is found in Table 5 and is further described in Appendix A. The cards used for the example run are listed in Figure 7. The time is input in tenths of an hour; e.g., 50 equals 5.0 hours.

	ID#	W	K	N	TD	TS
TS	AC311 -1	28	14	14	12	50
TS	AC312 -1	25		10		
TS	AC321 -1	50	14	13	12	50
TS	AC322 -1	08		10	12	50
TS	AC323 -1	59		07	12	50
TS	AC331 -1	31	28		12	50
TS	AC332 -1	45		35	12	50
TS	AC333 -1	25	14		12	50
TS	AC334 -1	15		06		
TS	AN111 -1			08	12	50
TS	AN121 -1	33	11	20	12	50
TS	AN122 -1			05	12	50
TS	AN131 -1	11	07	17	12	50
TS	AN132 -1			02		

Figure 7. Printout of the TS cards for the example run

Table 5

Task Time – Shop File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – TS	2	A	F	–
3	Blank	1	–	–	–
4	Weapon System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13 - 19	Blank	7	–	–	–
20 - 24	(W) Bench Check & Repair Time	5	N	R	1
25	Blank	1	–	–	–
26 - 30	(K) Bench Check & CND Time	5	N	R	1
31	Blank	1	–	–	–
32 - 36	(N) Bench Check & NRTS Time	5	N	R	1
37 - 49	Blank	13	–	–	–
50 - 54	(TD) Test Drawer Repair Time	5	N	R	1
55	Blank	1	–	–	–
56 - 60	(TS) Test Station Repair Time	5	N	R	1
60 - 80	Blank	20	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type TF - Task Time - Flight Line File

The flight line task time (TF) cards, like the TS cards, provide the average time, by subsystem, to accomplish the flight line maintenance task events. One card must be provided for each subsystem and organized in the same order as the CR cards for efficient program operation and ease of editing. The card format is provided in Table 6 and further described in Appendix A. The cards used for the example run are listed in Figure 8.

	ID#	A	T	CND	R	M	VR	VM
TF	AC310 -1	02	05	20	15	26	01	01
TF	AC320 -1	02	02	08	14	11	05	05
TF	AC330 -1	02	10	10	10	06	05	05
TF	AN110 -1	02	10	16	15	14	09	09
TF	AN120 -1	02	05	18	10	08	05	02
TF	AN130 -1	02	02	27	10	10	04	02

Figure 8. Printout of TF cards for example run

Table 6

Task Time – Flight Line File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – TF	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13	Blank	1	–	–	–
14 - 18	(A) Time to Set Up Support Equipment	5	N	R	1
19	Blank	1	–	–	–
20 - 24	(T) Troubleshooting Time	5	N	R	1
25	Blank	1	–	–	–
26 - 30	(C) Cannot Duplicate Discrepancy Time	5	N	R	1
31	Blank	1	–	–	–
32 - 36	(R) Time to Remove & Replace (R&R)	5	N	R	1
37	Blank	1	–	–	–
38 - 42	(M) On Aircraft (A/C) Maint. Time	5	N	R	1
43	Blank	1	–	–	–
44 - 48	(V_R) R&R Verification Time	5	N	R	1
49	Blank	1	–	–	–
50 - 54	(V_M) On A/C Maintenance Verif. Time	5	N	R	1
55 - 80	Blank	26	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type PF - Probability - Flight Line File

The flight line probability (PF) cards provide the probability of occurrence of each flight line maintenance task event. One card of type PF is required for each subsystem. They may be in any order, but placing them in the same order as the CR cards is recommended for more efficient program operation and for ease of editing. The card format is provided in Table 7 and further described in Appendix A. A printout of the cards used in the example run are shown in Figure 9.

	ID#	A	T	CND	R	M	VR	VR
PF	AC310 -1	10000	8800	1200	5280	3520	5280	3520
PF	AC320 -1	10000	8700	1300	7569	1131	7569	1131
PF	AC330 -1	10000	9300	0700	2790	6510	2790	6510
PF	AN110 -1	10000	8600	1400	6280	2320	6280	2320
PF	AN120 -1	10000	9600	0400	8256	1344	8256	1344
PF	AN130 -1	10000	9200	0800	6624	2576	6624	2576

Figure 9. Printout of the PF cards for the example run

Table 7

P Probability – Flight Line File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – PF	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13	Blank	1	–	–	–
14 - 18	P_A – Set Up Support Equipment	5	N	R	4
19	Blank	1	–	–	–
20 - 24	P_T – Troubleshoot	5	N	R	4
25	Blank	1	–	–	–
26 - 30	P_C – Cannot Duplicate Discrepancy	5	N	R	4
31	Blank	1	–	–	–
32 - 36	P_R – Remove & Replace (R&R)	5	N	R	4
37	Blank	1	–	–	–
38 - 42	P_M – On Aircraft (A/C) Maintenance	5	N	R	4
43	Blank	1	–	–	–
44 - 48	PV_R – R&R Verification	5	N	R	4
49	Blank	1	–	–	–
50 - 54	PV_M – On A/C Maintenance Verification	5	N	R	4
55 - 80	Blank	26	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type PS - Probability - Shop File

The shop probability (PS) cards, like the PF cards, provide the probability of occurrence of each maintenance task event performed on each LRU received in the shop. One card must be provided for each LRU, preferably in the same order as the CR cards to simplify editing and make program operation more efficient. The card format is listed in Table 8 and further described in Appendix A. A printout of the cards used in the example run are shown in Figure 10.

	ID#	W	K	N	TD	TS
PS	AC311 -1	1126	0423	1971	0317	0188
PS	AC312 -1	0880		0880		
PS	AC321 -1	6790	0295	0295	1993	0168
PS	AC322 -1	0076		0009	0020	0003
PS	AC323 -1	0052		0052	0016	0002
PS	AC331 -1	0272	0189		0125	0105
PS	AC332 -1	0216		0438	0124	0017
PS	AC333 -1	0623	0166		0213	0018
PS	AC334 -1	0443		0443		
PS	AN111 -1			6280	1319	0115
PS	AN121 -1	7228	0318	0397	2145	0181
PS	AN122 -1			0313	0059	0008
PS	AN131 -1	5503	0842	0129	1748	0148
PS	AN132 -1			0150		

Figure 10. Printout of the PS cards used for the example run

Table 8

P Probability – Shop File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – PS	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Organizational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13 - 19	Blank	7	–	–	–
20 - 24	P_W – Bench Check & Repair	5	N	R	4
25	Blank	1	–	–	–
26 - 30	P_K – Bench Check & RTOK	5	N	R	4
31	Blank	1	–	–	–
32 - 36	P_N – Bench Check & NRTS	5	N	R	4
37 - 49	Blank	13	–	–	–
50 - 54	P_{TD} – Test Drawer Repair	5	N	R	4
55	Blank	1	–	–	–
56 - 60	P_{TS} – Test Station Repair	5	N	R	4
61 - 80	Blank	20	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type SS - Support Equipment - Shop File

The shop support equipment (SS) cards identify for the model which test station(s) and what drawer number within the station will be used to test each LRU received by the shop for maintenance. The SS card can also be used to list test equipment that would be used to maintain the test station. The current maximum number of test stations per LRU that the model will recognize is two. When a second station is necessary, the data are assigned to a second card with a -2 sequence. At least one card must be assigned to each LRU, preferably in the same order as the CR cards for more efficient program operation and to simplify editing. The format is provided in Table 9 and further described in Appendix A. A printout of the cards used for the example run are shown in Figure 11.

	ID#	W	K	N	TD#	TD	TS	#
SS	AC311 -1	DTS	DTS	DTS	012	DTS		1
SS	AC312 -1				013			0
SS	AC321 -1	CNITM	CNITM	CNITM	014	CNITM		1
SS	AC322 -1	CNITM		CNITM	015	CNITM		1
SS	AC323 -1	CNITM		CNITM	016	CNITM		1
SS	AC331 -1	CNITM	CNITM		017	CNITM		1
SS	AC332 -1	CNITM		CNITM	018	CNITM		1
SS	AC333 -1	CNITM	CNITM		019	CNITM		1
SS	AC334 -1				020			0
SS	AN111 -1			CMPTS	027	CMPTS		1
SS	AN121 -1	CNITM	CNITM	CNITM	028	CNITM		1
SS	AN122 -1			CNITM	029	CNITM		1
SS	AN131 -1	CNITM	CNITM	CNITM	030	CNITM		1
SS	AN132 -1				031			0

Figure 11. Printout of SS cards for the example run

Table 9

Support Equipment (SE) – Shop File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – SS	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	2	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13 - 19	Blank	7	–	–	–
20 - 24	(W) SE to Bench Check & Repair	5	X	L	–
25	Blank	1	–	–	–
26 - 30	(K) SE to Bench Check & CND	5	X	L	–
31	Blank	1	–	–	–
32 - 36	(N) SE to Bench Check & NRTS	5	X	L	–
37	Blank	1	–	–	–
38 - 40	Test Drawer Number	3	N	R	–
41 - 49	Blank	9	–	–	–
50 - 54	(TD) SE Test Station Under Repair	5	X	L	–
55	Blank	1	–	–	–
56 - 60	(TS) SE to Check Out Test Station	5	X	L	–
61	Blank	1	–	–	–
62 - 63	Maximum No. of SE Per Task	2	N	R	–
64 - 80	Blank	17	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Card Type MF - Reliability Mean Values - Flight Line File

The flight line reliability mean value (MF) cards contain the mean flight hours between maintenance actions (MFHBMA) for each subsystem. An "H" factor showing the ratio of flight line LRU removals to shop receipts is also provided. The H factor values are input as an additive value greater than unity, and the program adds a one to this value. A further explanation of the H factor is provided in Appendix A for this card type.

There must be one MF card for every subsystem. They may be in any order, but placing them in the same order as the CR cards is recommended for more efficient program operation and for ease of editing. The format is found in Table 10 and further described in Appendix A. A printout of the cards used for the example run are shown in Figure 12. (Note: The example shows zero filled "H" factor" values, but the program does not require this data entry.)

```
      ID#       MFHBMA H.FACTOR

MF  AC310 -1   404.6 0.0000
MF  AC320 -1    62.9 0.0000
MF  AC330 -1   328.1 0.0000
MF  AN110 -1  1031.9 0.0000
MF  AN120 -1    62.9 0.0000
MF  AN130 -1   232.9 0.0000
```

Figure 12. Printout of the MF cards used for the example run

Table 10

Reliability Mean Values – Flight Line File

Column	Title	Length	Type*	Justification**	Decimal Placement
1 - 2	Card Type – MF	2	A	F	–
3	Blank	1	–	–	–
4	Aircraft System	1	A	F	–
5	Major System	1	A	F	–
6	Functional Group	1	A	F	–
7	Operational Function	1	N	F	–
8	Subsystem	1	N	F	–
9	Line Replaceable Unit	1	X	F	–
10	Shop Replaceable Unit	1	N	F	–
11	Dash	1	X	F	–
12	Card Sequence	1	N	F	–
13	Blank	1	–	–	–
14 - 19	Mean Flight Hours Between Maintenance Actions by subsystem (column 18 is a decimal)	6	N	R	1
20	Blank	1	–	–	–
21 - 26	H factor (column 22 is a decimal)	6	N	F	1
27 - 80	Blank	55	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

AFSC Cards - Air Force Specialty Code Definition

All AFSCs which were input in either an "LS" or "LF" input card must be defined here. The first card contains the number of AFSCs punched on the remaining cards. Each succeeding card may contain up to six AFSCs and the respective manhour rates. The AFSCs may be put in any order, and that ordering will be maintained in the AFSC output. If no manhour rate is input, $1 per hour will be used. The format is provided in Table 11. A printout of the cards used for the example run are shown in Figure 13a.

```
016
32251       32231       32651       32631       32652
32632       32850       32830       32851       32831
32853       32833       40451       40431       42153
43171
```

Figure 13a. Printout of AFSC definition cards for example run

SE Cards - Support Equipment Definition

All support equipments which were input in either an "SF" or "SS" input card must be defined here. The first card contains the number of SEs punched on the remaining cards. Each succeeding card contains up to 13 SEs. They may be put in any order, and that ordering will be maintained in the SE output. The format is provided in Table 12. A printout of the cards used for the example run are shown in Figure 13b.

```
06
MWTS  ARFTS CNITM DTS   ICTM  CMPTS
```

Figure 13b. Printout of SE definition cards for the example run

Table 11

AFSC Definition

Column	Title	Length	Type*	Justification**	Decimal Placement
(first card)					
1 - 3	Number of AFSCs	3	N	R	–
(succeeding cards)					
1 - 5	AFSC	5	N	L	–
6 - 11	AFSC manhour cost	6	N	R	2
13 - 17	AFSC	5	N	L	–
18 - 23	AFSC manhour cost	6	N	R	2
25 - 29	AFSC	5	N	L	–
30 - 35	AFSC manhour cost	6	N	R	2
37 - 41	AFSC	5	N	L	–
42 - 47	AFSC manhour cost	6	N	R	2
49 - 53	AFSC	5	N	L	–
54 - 59	AFSC manhour cost	6	N	R	2
61 - 65	AFSC	5	N	L	–
68 - 71	AFSC manhour cost	6	N	R	2
72 - 80	Blank	9	–	–	–

*A = alpha, N = numeric, x = alpha/numeric

**F = fixed, R = right, L = left

Table 12

Support Equipment Definition

Column	Title	Length	Type*	Justification**	Decimal Placement
(first card)					
1 - 2	Number of SEs	2	N	R	–
(succeeding cards)					
1 - 5	SE	5	X	L	–
7 - 11	SE	5	X	L	–
13 - 17	SE	5	X	L	–
19 - 23	SE	5	X	L	–
25 - 29	SE	5	X	L	–
31 - 35	SE	5	X	L	–
37 - 41	SE	5	X	L	–
43 - 47	SE	5	X	L	–
49 - 53	SE	5	X	L	–
55 - 59	SE	5	X	L	–
61 - 65	SE	5	X	L	–
67 - 71	SE	5	X	L	–
73 - 77	SE	5	X	L	–
78 - 80	Blank	3	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Option Card Formats

Program option cards immediately follow the data file cards of the R&M input deck. These cards are used to generate optional outputs of the model as described below.

AFSCs and SEs of Interest

This option specifies how many Air Force specialty code (AFSC) and support equipment (SE) reports are to be output and then defines them. The first card contains the count and the succeeding cards the AFSC or SE identifications. The format is provided in Table 13. If no AFSC or SE output is desired, a zero is entered in the first card and successive cards are omitted. To reduce the input requirements, the words ALLAF or ALLSE may be used in place of the AFSC or SE identifications to invoke output for all the AFSCs or all of the SEs.

A separate output report will be generated for each AFSC designated. Each report displays, for every subsystem requiring that AFSC, the MMH/1000 FH required for the total shop task events per LRU, the total flight line task events, and the total for the subsystem. An example output matrix is shown in Figure 18. A column of the matrix records the cost/1000 FH for each of these MMH/1000 FH outputs obtained by multiplying by the cost per MMH for that AFSC.

A separate output report of maintenance requirements will be generated for each SE designated. An example output matrix is shown in Figure 17. Each of these reports will provide values for (1) the Test Drawer Repair (TD REP) representing the in-shop repair of the test station drawer (or combination of test equipment) that is needed to test the LRU being checked, (2) the Test Station Repair (TS REP) representing the in-shop repair of the entire test station that is needed to test the LRU being checked and (3) their total. These TD REP, TS REP, and total values are provided for each of the individual LRUs tested on the particular test station and each is given in terms of MTTR, MMH, MMH/1000 FH, and MTTR/1000 FH.

Table 13

AFSC and SE Option Cards

Column	Title	Length	Type*	Justification**	Decimal Placement
(first card)					
1 - 3	Number of AFSCs and SEs requested	3	N	R	–
(succeeding cards)					
1 - 5		5	X	L	–
7 - 11		5	X	L	–
13 - 17		5	X	L	–
19 - 23		5	X	L	–
25 - 29		5	X	L	–
31 - 35	AFSC identification or	5	X	L	–
37 - 41	SE identification or	5	X	L	–
43 - 47	ALLAF or ALLSE	5	X	L	–
49 - 53		5	X	L	–
55 - 59		5	X	L	–
61 - 65		5	X	L	–
67 - 71		5	X	L	–
73 - 77		5	X	L	–
78 - 80		3	–	–	–

*A = alpha, N = numeric, X = alpha/numeric

**F = fixed, R = right, L = left

Subsystem Data Options

The following 13 option cards may occur in any number (or may be omitted) and in any order, with duplications if desired. They serve to call up optional output reports as described below. If none are included, no optional reports will be output. In every case, the subsystem name, or portion thereof, is punched in columns 1-7 and the option number (right-justified) in columns 9-10.

Option #	Title - Description
01	MTTR BY TASK PER LRU - displays mean time to repair for each LRU within the subsystem designated. If the subsystem field is left blank and only the option number is specified, one report will be generated for each subsystem and its LRUs.
02	MTTR AS % OF TOTAL - same as 01 except the values displayed are percentages of the total subsystem MTTR. Only the percentages are displayed.
03	MMH BY TASK PER LRU - displays maintenance manhours for each LRU within the subsystem designated. If the subsystem field is left blank and only the option number is specified, one report will be generated for each subsystem and its LRUs.
04	MMH AS % OF TOTAL - same as 03 except the values displayed are percentages of the total subsystem MMH. Only the percentages are displayed.
05	MMH PER 1000 FH - displays maintenance manhours per thousand flight hours reports for each LRU within the subsystem designated. If the subsystem field is left blank and only the option number is specified, one report will be generated for each subsystem and its LRUs.
06	MAINT INDEX x 1000 - displays the equipment maintainability index defined as MTTR per 1000 flight hours obtained from the equation (MTTR x 1000)/MFHBMA. If the subsystem field is left blank, one report will be generated for each subsystem and its LRUs.

Options 07 through 12 are similar to options 01 through 06, respectively, with the following two exceptions which apply to each option:

a) Only the bottom line total is given for each report rather than itemizing by LRU
b) Rather than each report representing outcomes of maintenance actions for a single subsystem, each can be stipulated to represent a summation over several subsystems as selected by the portion of the subsystem ID number punched in columns 1-7.

These exceptions can be noted in the example run, whereby "AC3" was used as the operational function group ID for options 07 through 12. All subsystems beginning with "AC3" are then used in the summation. Any number of characters may be used as the portion of the subsystem ID. This makes possible the selection of outputs for any hierarchical grouping of subsystems desired. This relationship of ID number to hierarchical order of the equipment is illustrated in Figure 2.

Option #	Title	- Description
13	MTTR for All Subsystems and MMH for All Subsystems	- this option requires no entry in the subsystem field (columns 1-7) and produces two reports summing the MTTR and MMH for all subsystems.

Figure 14 shows the input option cards which immediately follow the input data file cards. This set of option cards was used in the example run to generate the sample output reports used in this report.

```
002
ALLAF ALLSE
          13
          01
 AC320    02
          03
 AC320    04
          05
          06
 AC3      07
 AC3      08
 AC3      09
 AC3      10
 AC3      11
 AC3      12
```

Figure 14. Printout of input options cards for the example run

V. OUTPUT REPORTS

Structure of the Example Run

The R&M model is capable of providing the user with up to 16 output reports. In addition, a complete listing of the R&M input data is printed out for verification by the user. Figure 15 is a print-out of the data used for the example run; complete instructions for its preparation have been provided in Section IV and Appendix A of this volume. Figure 16 displays the first report printed when the R&M model batch program is run. It is the "Subsystem Inherent Flight Line Availability" report which displays this parameter for all subsystems ranked by order of magnitude. This report is always printed first and is not optionally controlled.

Samples of the support equipment (SE) matrices (Figure 17) and AFSC matrices (Figure 18) were selected from the set requested on the option cards previously shown in Figure 14. One report matrix for each requested SE and AFSC is produces when the R&M model is run. Formats for these reports are described on page 43.

Optional output reports 01 through 13 are printed next (Figures 19 through 32) in the order they were requested (Figure 14). The format of these output reports is similarly structured. Briefly, the first line of the report names the value computed and the terms of the computation. The second line provides the subsystem identification (ID) number, work unit code (WUC) in parentheses, equipment name, and the mean flight hours between maintenance action value for the specified subsystem. The third line provides the user with the column headings that describe the data elements contained in the output matrices for each maintenance event.

The column titles are:

AGE F/L	setup support equipment event on the flight line
TS F/L	troubleshooting event on the flight line
R&R	remove and replace event
VR&R	verification event of removal and replacement
CND A/C	troubleshooting event on the aircraft, cannot duplicate the discrepancy

M A/C	minor maintenance on aircraft event
VM A/C	verification event, that the maintenance performed corrected the discrepancy
SHOP	bench check, test, and repair events of units removed to the shop
TOT/OUT	total per outcome

The fourth line provides the line replaceable unit (LRU), ID number, WUC, and equipment name, which is repeated for each set of LRU data displayed.

Descriptions of lines two and four apply only to report options 01 through 06.

The rows of data that follow these headings contain the computed values broken out by task event for each of the following maintenance action outcomes:

W	bench check and repair outcome
K	bench tested and found serviceable outcome (no maintenance required)
N	not repairable this station (NRTS) outcome which is a return to depot for repair
SUB	subtotal for the shop tasks required for the LRU
CND	cannot duplicate the discrepancy outcome
TOT/TSK	total for the task

For detailed descriptions of the output reports, including equations, definitions, and example calculations the user should reference Section IV of AFHRL-TR-78-2(I), the companion technical report to this user's guide.

```
DAIS THEORETICAL  RELIABILITY AND MAINTAINABILITY MODEL
06
CR   AC310 -1         63510   1 DATA LINK                                    2
CR   AC310 -2         63150                              AN/ASW- 25
CR   AC311 -1   11.8  63511   1 CONVERTER/RECEIVER                           8
CR   AC311 -2         63511                              CV-2230A/ASW-25
CR   AC312 -1    2.0  63515   1 MOUNT & ANTENNA                              1
CR   AC320 -1         63A00   1 UHF RADIO SET                                3
CR   AC320 -2         63A00                              AN/ARC- 51BX
CR   AC321 -1   27.7  63AA0   1 RECEIVER/TRANSMITTER (UHF)                   9
CR   AC321 -2         63AA0     5821-00-134-6239         RT-742B/ARC-51BX
CR   AC322 -1    1.0  63AE0   1 DIPLEXER                                     2
CR   AC323 -1    1.1  63AL0   1 STANDING WAVE RATIO INDICATOR                1
CR   AC323 -2         63AL0     5821-00-978-7867         ID-1003/ARC
CR   AC330 -1         63B00   1 AUTOMATIC DIRECTION FINDING SET - UHF        4
CR   AC330 -2         63B00                              AN/ARA- 50
CR   AC331 -1    5.4  63BA0   1 RELAY AMPLIFIER                              2
CR   AC331 -2         63BA0     5826-00-059-2726         AM-3624/ARA-50
CR   AC332 -1   10.0  63BB0   1 ANTENNA                                      1
CR   AC332 -2         63BB0     5826-00-849-0055         AS-909/ARA-48
CR   AC333 -1    8.0  63BC0   1 RECEIVER                                     7
CR   AC333 -2         63BC0     5821-00-999-4590-MA      R-1286/ARR-69
CR   AC334 -1    1.1  63BF0   1 MOUNT                                        1
CR   AN110 -1         71A00   1 HEADING MODE SYSTEM                          1
CR   AN111 -1    4.0  71AD0   1 RATE GYRO TRANSMITTER                        1
CR   AN120 -1         71B00   1 TACAN SET                                    2
CR   AN120 -2         71B00                              AN/ARN- 52
CR   AN121 -1   43.3  71BA0   1 RECEIVER/TRANSMITTER (TACAN)                 8
CR   AN121 -2         71BA0     5826-00-884-0914         RT-893/ARN-52
CR   AN122 -1    2.3  71BB0   1 ANTENNA SWITCH                               1
```

Figure 15. Input data records

```
CR  AN130 -1        71C00  1 INSTRUMENT LANDING SYSTEM                          2
CR  AN130 -2        71C00                          AN/ARN- 58A
CR  AN131 -1   8.6  71CA0  1 RADIO MARKER BEACON & GLIDESLOPE REC              6
CR  AN131 -2        71CA     5826-00-226-6030    R-844A/ARN-58A
CR  AN132 -1   4.0  71CC0  1 ANTENNA                                           1
CR  AN132 -2
SF  AC310 -1 D60    D60    D60    D60    D60    D60    D60
SF  AC320 -1 D60    D60    D60    D60    D60    D60    D60
SF  AC330 -1 D60    D60    D60    D60    D60    D60    D60
SF  AN110 -1 D60    D60    D60    D60    D60    D60    D60
SF  AN120 -1 D60    D60    D60    D60    D60    D60    D60
SF  AN130 -1 D60    D60    D60    D60    D60    D60    D60
LF  AC310 -1 43171  32833  32853  32833  32853  32853  32853  2
LF  AC310 -2 42153                                  32833  32833
LF  AC320 -1 43171  32833  32853  32833  32853  32853  32853  2
LF  AC320 -2 42153         32833         32833
LF  AC330 -1 43171  32833  32853  32833  32853  32853  32853  2
LF  AC330 -2 42153         32833         32833  32833  32833
LF  AN110 -1 43171  32831  32851  32831  32851  32851  32851  2
LF  AN110 -2 42153         32831         32831
LF  AN120 -1 43171  32831  32851  32831  32851  32851  32851  2
LF  AN120 -2 42153         32831         32831
LF  AN130 -1 43171  32831  32851  32831  32851  32851  32851  2
LF  AN130 -2 42153         32831         32831  32831  32831
LS  AC311 -1        32850  32850  32850                3265A  3265A  2
LS  AC311 -2        32830                              3263A  3263A
LS  AC312 -1        32850         32850                              2
LS  AC312 -2        32830
LS  AC321 -1        32850  32850  32850                3265A  3265A  2
LS  AC321 -2        32830                              3263A  3263A
```

Figure 15. (continued)

LS	AC322 -1	32850		32850	3265A	3265A	2
LS	AC322 -2				3263A	3263A	
LS	AC323 -1	32850		32850	3265A	3265A	2
LS	AC323 -2				3263A	3263A	
LS	AC331 -1	32850	32850		3265A	3265A	2
LS	AC331 -2	32830			3263A	3263A	
LS	AC332 -1	32850		32850	3265A	3265A	2
LS	AC332 -2	32830			3263A	3263A	
LS	AC333 -1	32850	32850		3265A	3265A	2
LS	AC333 -2	32830			3263A	3263A	
LS	AC334 -1	32850		32850	3265A	3265A	2
LS	AC334 -2	32830			3263A	3263A	
LS	AN111 -1			32651			2
LS	AN111 -2				3265B	3265B	2
LS	AN121 -1	32850	32850	32850	3263B	3265B	
LS	AN121 -2	32830			3265A	3265A	2
LS	AN122 -1			32850	3263A	3263A	
LS	AN122 -2				3265A	3265A	2
LS	AN131 -1	32850	32850	32850	3263A	3263A	
LS	AN131 -2	32830			3265A	3265A	2
LS	AN132 -1			32850	3263A	3263A	
TS	AC311 -1	28	14	14			1
TS	AC312 -1	25		10	12	50	
TS	AC321 -1	50	14	13	12	50	
TS	AC322 -1	08		10	12	50	
TS	AC323 -1	59		07	12	50	
TS	AC331 -1	31	28		12	50	
TS	AC332 -1	45		35	12	50	
TS	AC333 -1	25	14		12	50	
TS	AC334 -1	15		06			

Figure 15. (continued)

TS	AN111 -1				08			12	50
TS	AN121 -1		33	11	20			12	50
TS	AN122 -1				05			12	50
TS	AN131 -1		11	07	17			12	50
TS	AN132 -1				02				
TF	AC310 -1	02	05	20	15	26	01	01	
TF	AC320 -1	02	02	08	14	11	05	05	
TF	AC330 -1	02	10	10	10	06	05	05	
TF	AN110 -1	02	10	16	15	14	09	09	
TF	AN120 -1	02	05	18	10	08	05	02	
TF	AN130 -1	02	02	27	10	10	04	02	
PF	AC310 -1	10000	8800	1200	5280	3520	5280	3520	
PF	AC320 -1	10000	8700	1300	7569	1131	7569	1131	
PF	AC330 -1	10000	9300	0700	2790	6510	2790	6510	
PF	AN110 -1	10000	8600	1400	6280	2320	6280	2320	
PF	AN120 -1	10000	9600	0400	8256	1344	8256	1344	
PF	AN130 -1	10000	9200	0800	6624	2576	6624	2576	
PS	AC311 -1		1126	0423	1971			0317	0188
PS	AC312 -1		0880		0880				
PS	AC321 -1		6790	0295	0295			1993	0168
PS	AC322 -1		0076		0009			0020	0003
PS	AC323 -1		0052		0052			0016	0002
PS	AC331 -1		0272	0189				0125	0105
PS	AC332 -1		0216		0438			0124	0017
PS	AC333 -1		0623	0166				0213	0018
PS	AC334 -1		0443		0443				
PS	AN111 -1				6280			1319	0115
PS	AN121 -1		7228	0318	0397			2145	0181
PS	AN122 -1				0313			0059	0008
PS	AN131 -1		5503	0842	0129			1748	0148

Figure 15. (continued)

```
PS   AN132 -1                                0150
SS   AC311 -1        DTS    DTS    DTS      012          DTS          1
SS   AC312 -1                               013                       0
SS   AC321 -1        CNITM  CNITM  CNITM    014          CNITM        1
SS   AC322 -1        CNITM         CNITM    015          CNITM        1
SS   AC323 -1        CNITM         CNITM    016          CNITM        1
SS   AC331 -1        CNITM  CNITM           017          CNITM        1
SS   AC332 -1        CNITM         CNITM    018          CNITM        1
SS   AC333 -1        CNITM  CNITM           019          CNITM        1
SS   AC334 -1                               020                       0
SS   AN111 -1                       CMPTS   027          CMPTS        1
SS   AN121 -1        CNITM  CNITM  CNITM    028          CNITM        1
SS   AN122 -1                       CNITM    029          CNITM        1
SS   AN131 -1        CNITM  CNITM  CNITM    030          CNITM        1
SS   AN132 -1                               031                       0
MF   AC310 -1   404.6 0.0000
MF   AC320 -1    62.9 0.0000
MF   AC330 -1   328.1 0.0000
MF   AN110 -1  1031.9 0.0000
MF   AN120 -1    62.9 0.0000
MF   AN130 -1   232.9 0.0000
016
32251          32231          32651          32631          32652
32632          32850          32830          32851          32831
32853          32833          40451          40431          42153
43171
06
MWTS  ARFTS CNITM DTS   ICTM  CMPTS
```

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Figure 15. (continued)

SUBSYSTEM INHERENT FLIGHT LINE AVAILABILITY

SUBSYSTEM	AVAILABILITY
AN120	0.9673
AC320	0.9677
AN130	0.9922
AC330	0.9929
AC310	0.9934
AN110	0.9968

SERVICE FLIGHT LINE AVAILABILITY-
0.9132

Figure 16. Sample availability report

SE-CNTR	TSK	-MTTR- TO REP	TS REP	TOTAL	-MMH- TO REP	TS REP	TOTAL	-MMH/1000 FH- TO REP	TS REP	TOTAL	-MTTR/1000 FH- TO REP	TS REP	TOTA
AC111	6	0.0823	0.0210	0.1033	0.1646	0.0420	0.2066	3.2282	0.8235	4.0518	1.6141	0.4118	2.025
AC112	7	0.0490	0.0270	0.0760	0.0979	0.0540	0.1519	1.9200	1.0588	2.9788	0.9600	0.5296	1.489
AC113	8	0.0154	0.0085	0.0239	0.0307	0.0170	0.0477	0.6024	0.3333	0.9357	0.3012	0.1667	0.468
AC114	9	0.0162	0.0090	0.0252	0.0324	0.0180	0.0504	0.6353	0.3529	0.9882	0.3176	0.1765	0.494
AC110		0.1628	0.0655	0.2283	0.3257	0.1310	0.4567	6.3859	2.5686	8.9545	3.1929	1.2843	4.477
AC211	10	0.1777	0.0625	0.2402	0.3554	0.1250	0.4804	4.7519	1.6711	6.4230	2.3759	0.8356	3.211
AC212	11	0.0028	0.0015	0.0043	0.0055	0.0030	0.0085	0.0738	0.0401	0.1139	0.0369	0.0201	0.057
AC210		0.1805	0.0640	0.2445	0.3610	0.1280	0.4890	4.8257	1.7112	6.5369	2.4128	0.8556	3.268
AC311	12	0.0380	0.0940	0.1320	0.0761	0.1880	0.2641	0.1880	0.4647	0.6527	0.0940	0.2323	0.326
AC310		0.0380	0.0940	0.1320	0.0761	0.1880	0.2641	0.1880	0.4647	0.6527	0.0940	0.2323	0.326
AC321	14	0.2392	0.0840	0.3232	0.4783	0.1680	0.6463	7.6045	2.6709	10.2754	3.8022	1.3355	5.137
AC322	15	0.0024	0.0015	0.0039	0.0048	0.0030	0.0078	0.0763	0.0477	0.1240	0.0382	0.0238	0.062
AC323	16	0.0019	0.0010	0.0029	0.0038	0.0020	0.0058	0.0610	0.0318	0.0928	0.0305	0.0159	0.046
AC320		0.2435	0.0865	0.3300	0.4870	0.1730	0.6600	7.7418	2.7504	10.4922	3.8709	1.3752	5.246
AC331	17	0.0150	0.0525	0.0675	0.0300	0.1050	0.1350	0.0914	0.3200	0.4115	0.0457	0.1600	0.205
AC332	18	0.0149	0.0085	0.0234	0.0298	0.0170	0.0468	0.0908	0.0518	0.1425	0.0454	0.0259	0.071
AC333	19	0.0256	0.0090	0.0346	0.0511	0.0180	0.0691	0.1558	0.0549	0.2107	0.0779	0.0274	0.105
AC330		0.0554	0.0700	0.1254	0.1109	0.1400	0.2509	0.3379	0.4267	0.7646	0.1690	0.2133	0.382
AC411	21	0.0416	0.0040	0.0456	0.0833	0.0080	0.0913	0.5559	0.0534	0.6093	0.2780	0.0267	0.304
AC412	22	0.0316	0.0030	0.0346	0.0631	0.0060	0.0691	0.4214	0.0401	0.4614	0.2107	0.0200	0.230
AC413	23	0.0132	0.0010	0.0142	0.0264	0.0020	0.0284	0.1762	0.0134	0.1896	0.0881	0.0067	0.094
AC410		0.0864	0.0080	0.0944	0.1728	0.0160	0.1888	1.1535	0.1068	1.2603	0.5768	0.0534	0.630
AC511	24	0.2777	0.0700	0.3477	0.5554	0.1400	0.6954	0.8574	0.2161	1.0736	0.4287	0.1081	0.536
AC510		0.2777	0.0700	0.3477	0.5554	0.1400	0.6954	0.8574	0.2161	1.0736	0.4287	0.1081	0.536
AC611	25	0.1643	0.0415	0.2058	0.3286	0.0830	0.4116	2.7221	0.6877	3.4098	1.3611	0.3438	1.704
AC612	26	0.0035	0.0020	0.0055	0.0070	0.0040	0.0110	0.0577	0.0331	0.0908	0.0288	0.0166	0.045
AC610		0.1678	0.0435	0.2113	0.3355	0.0870	0.4225	2.7798	0.7208	3.5006	1.3899	0.3604	1.750
AN121	28	0.2574	0.0905	0.3479	0.5148	0.1810	0.6958	8.1864	2.8776	11.0620	4.0922	1.4388	5.531
AN122	29	0.0071	0.0040	0.0111	0.0142	0.0080	0.0222	0.2251	0.1272	0.3523	0.1126	0.0636	0.176
AN120		0.2645	0.0945	0.3590	0.5290	0.1890	0.7180	8.4095	3.0048	11.4143	4.2048	1.5024	5.707
AN131	30	0.2098	0.0740	0.2838	0.4195	0.1480	0.5675	1.8013	0.6355	2.4368	0.9006	0.3177	1.218
AN130		0.2098	0.0740	0.2838	0.4195	0.1480	0.5675	1.8013	0.6355	2.4368	0.9006	0.3177	1.218
AN211	32	0.2448	0.0860	0.3308	0.4896	0.1720	0.6616	9.0000	3.1618	12.1618	4.5000	1.5809	6.080
AN213	34	0.0128	0.0070	0.0198	0.0257	0.0140	0.0397	0.4721	0.2574	0.7296	0.2360	0.1287	0.364
AN210		0.2576	0.0930	0.3506	0.5153	0.1860	0.7013	9.4721	3.4191	12.8912	4.7360	1.7096	6.445
TOTAL		1.9440	0.7630	2.7070	3.8880	1.5260	5.4140	43.9530	16.0247	59.9777	21.9765	8.0124	29.988

Figure 17. Sample SE maintenance requirements report

APBC-32830 $ 1.00

	MMH/KFH	COST/KFH
AC111	13.43961	13.43961
AC112	18.18980	18.18980
AC113	3.96471	3.96471
AC114	6.00549	6.00549
FL	0.	0.
AC110	41.59961	41.59961
AC211	23.18182	23.18182
AC212	0.26310	0.26310
FL	0.	0.
AC210	23.44492	23.44492
AC311	0.77924	0.77924
AC312	0.54375	0.54375
FL	0.	0.
AC310	1.32299	1.32299
AC321	53.97456	53.97456
FL	0.	0.
AC320	53.97456	53.97456
AC331	0.25699	0.25699
AC332	0.29625	0.29625
AC333	0.47470	0.47470
AC334	0.20253	0.20253
FL	0.	0.
AC330	1.23048	1.23048
AC411	1.93565	1.93565
FL	0.	0.
AC410	1.93565	1.93565
AC511	2.03008	2.03008
FL	0.	0.
AC510	2.03008	2.03008
AC612	0.12759	0.12759
FL	0.	0.
AC610	0.12759	0.12759
AM121	37.92114	37.92114
FL	0.	0.
AM120	37.92114	37.92114
AM131	2.59910	2.59910
FL	0.	0.
AM130	2.59910	2.59910
AM211	39.04779	39.04779
FL	0.	0.
AM210	39.04779	39.04779
TOTAL	205.23391	205.23391

Figure 18. Sample manpower report

MTTR FOR ALL SUBSYSTEMS

SUBSYS	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
AC310	0.2000	0.4400	0.7919	0.0528	0.2400	0.9152	0.0352	0.9583	3.6333
AC320	0.2000	0.1740	1.0599	0.3785	0.1040	0.1244	0.0566	3.5306	5.6181
AC330	0.2000	0.9200	0.2790	0.1395	0.0700	0.3906	0.3255	0.6598	2.9944
AN110	0.2000	0.8600	0.9420	0.5652	0.2240	0.3248	0.2088	0.5024	3.8272
AN120	0.2000	0.4800	0.8256	0.4128	0.0720	0.1075	0.0269	2.5153	4.6401
AN130	0.2000	0.1840	0.6624	0.2650	0.2160	0.2576	0.0515	0.6892	2.5257
TOTAL	1.2000	3.0680	4.5608	1.8138	0.9260	2.1201	0.7045	8.8555	23.2487

Figure 19. Sample option 13 report (part 1)

MMH FOR ALL SUBSYSTEMS

SUBSYS	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
AC310	0.4000	0.4400	0.7919	0.1056	0.2400	0.9152	0.0704	1.4936	4.4565
AC320	0.4001	0.1740	1.0599	0.3785	0.2080	0.1244	0.1131	6.9261	9.3842
AC330	0.4000	0.9380	0.2790	0.2790	0.1400	0.7812	0.6510	1.0635	4.5237
AN110	0.4000	0.8600	0.9420	0.5652	0.4480	0.6496	0.2088	0.5024	4.5760
AN120	0.4000	0.4800	0.8256	0.4128	0.1440	0.2150	0.0269	4.9005	7.4048
AN130	0.4000	0.1840	0.6624	0.5299	0.4320	0.5152	0.1030	1.2945	4.1211
TOTAL	2.4000	3.0680	4.5608	2.2711	1.6120	3.2007	1.1732	16.1806	34.4663

Figure 20. Sample option 13 report (part 2)

MTTR BY TASK PER LRU

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321 (63AA0) RECEIVER/TRANSMITTER (UHF)									
W	0.13580	0.13580	0.95060	0.33950				3.39500	4.95670
K	0.00590	0.00590	0.04130	0.01475				0.04130	0.10915
N	0.00590	0.00590	0.04130	0.01475				0.03835	0.10620
SUB	0.14760	0.14760	1.03320	0.36900				3.47465	5.17205
LRU- AC322 (63AE0) DIPLEXER									
W	0.00158	0.00158	0.01106	0.00395				0.00632	0.02449
K	0.	0.	0.	0.				0.	0.
N	0.00018	0.00018	0.00126	0.00045				0.00090	0.00297
SUB	0.00176	0.00176	0.01232	0.00440				0.00722	0.02746
LRU- AC323 (63AL0) STANDING WAVE RATIO INDICATOR									
W	0.00104	0.00104	0.00728	0.00260				0.03068	0.04264
K	0.	0.	0.	0.				0.	0.
N	0.00104	0.00104	0.00728	0.00260				0.00364	0.01560
SUB	0.00208	0.00208	0.01456	0.00520				0.03432	0.05824
CND	0.02600				0.10400				0.13000
M	0.02262	0.02262				0.12441	0.05655		0.22620
TOT/TSK	0.20006	0.17406	1.06008	0.37860	0.10400	0.12441	0.05655	3.51619	5.61395

Figure 21. Sample option 01 report

MTTR AS % OF TOTAL

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321	(63AA0)	RECEIVER/TRANSMITTER (UHF)							
W	2.419	2.419	16.933	6.047				60.474	88.293
K	0.105	0.105	0.736	0.263				0.736	1.944
N	0.105	0.105	0.736	0.263				0.683	1.892
SUB	2.629	2.629	18.404	6.573				61.893	92.129
LRU- AC322	(63AE0)	DIPLEXER							
W	0.028	0.028	0.197	0.070				0.113	0.436
K	0.	0.	0.	0.				0.	0.
N	0.003	0.003	0.022	0.008				0.016	0.053
SUB	0.031	0.031	0.219	0.078				0.129	0.489
LRU- AC323	(63AL0)	STANDING WAVE RATIO INDICATOR							
W	0.019	0.019	0.130	0.046				0.546	0.760
K	0.	0.	0.	0.				0.	0.
N	0.019	0.019	0.130	0.046				0.065	0.278
SUB	0.037	0.037	0.259	0.093				0.611	1.037
CND	0.463				1.853				2.316
M	0.403	0.403				2.216	1.007		4.029
TOT/TSK	3.564	3.100	18.883	6.744	1.853	2.216	1.007	62.633	100.000

Figure 22. Sample option 02 report

MMH BY TASK PER LRU

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321 (63AA0) RECEIVER/TRANSMITTER (UHF)									
W	0.27160	0.13580	0.95060	0.33950				6.79000	8.48750
K	0.01180	0.00590	0.04130	0.01475				0.04130	0.11505
N	0.01180	0.00590	0.04130	0.01475				0.03835	0.11210
SUB	0.29520	0.14760	1.03320	0.36900				6.86965	8.71465
LRU- AC322 (63AE0) DIPLEXER									
W	0.00316	0.00158	0.01106	0.00395				0.00632	0.02607
K	0.	0.	0.	0.				0.	0.
N	0.00036	0.00018	0.00126	0.00045				0.00090	0.00315
SUB	0.00352	0.00176	0.01232	0.00440				0.00722	0.02922
LRU- AC323 (63AL0) STANDING WAVE RATIO INDICATOR									
W	0.00208	0.00104	0.00728	0.00260				0.03068	0.04368
K	0.	0.	0.	0.				0.	0.
N	0.00208	0.00104	0.00728	0.00260				0.00364	0.01664
SUB	0.00416	0.00208	0.01456	0.00520				0.03432	0.06032
CND	0.05200				0.20800				0.26000
M	0.04524	0.02262				0.24882	0.05655		0.37323
TOT/TSK	0.40012	0.17406	1.06008	0.37860	0.20800	0.24882	0.05655	6.91119	9.43742

Figure 23. Sample option 03 report

MMH AS % OF TOTAL

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321 (63AA0) RECEIVER/TRANSMITTER (UHF)									
W	2.878	1.439	10.073	3.597				71.948	89.935
K	0.125	0.063	0.438	0.156				0.438	1.219
N	0.125	0.063	0.438	0.156				0.406	1.188
SUB	3.128	1.564	10.948	3.910				72.792	92.341
LRU- AC322 (63AE0) DIPLEXER									
W	0.033	0.017	0.117	0.042				0.067	0.276
K	0.	0.	0.	0.				0.	0.
N	0.004	0.002	0.013	0.005				0.010	0.033
SUB	0.037	0.019	0.131	0.047				0.077	0.310
LRU- AC323 (63AL0) STANDING WAVE RATIO INDICATOR									
W	0.022	0.011	0.077	0.028				0.325	0.463
K	0.	0.	0.	0.				0.	0.
N	0.022	0.011	0.077	0.028				0.039	0.176
SUB	0.044	0.022	0.154	0.055				0.364	0.639
CND	0.551				2.204				2.755
M	0.479	0.240				2.637	0.599		3.955
TOT/TSK	4.240	1.844	11.233	4.012	2.204	2.637	0.599	73.232	100.000

Figure 24 Sample option 04 report

MMH PER 1000 FH

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321 (63AA0) RECEIVER/TRANSMITTER (UHF)									
W	4.318	2.159	15.113	5.397				107.949	134.936
K	0.188	0.094	0.657	0.234				0.657	1.829
N	0.188	0.094	0.657	0.234				0.610	1.782
SUB	4.693	2.347	16.426	5.866				109.215	138.548
LRU- AC322 (63AE0) DIPLEXER									
W	0.050	0.025	0.176	0.063				0.100	0.414
K	0.	0.	0.	0.				0.	0.
N	0.006	0.003	0.020	0.007				0.014	0.050
SUB	0.056	0.028	0.196	0.070				0.115	0.465
LRU- AC323 (63AL0) STANDING WAVE RATIO INDICATOR									
W	0.033	0.017	0.116	0.041				0.488	0.694
K	0.	0.	0.	0.				0.	0.
N	0.033	0.017	0.116	0.041				0.058	0.265
SUB	0.066	0.033	0.231	0.083				0.546	0.959
CND	0.827				3.307				4.134
M	0.719	0.360				3.956	0.899		5.934
TOT/TSK	6.361	2.767	16.853	6.019	3.307	3.956	0.899	109.876	150.038

Figure 25. Sample option 05 report

MAINT. INDEX X 1000

SUBSYSTEM- AC320 (63A00) UHF RADIO SET MFHBMA= 62.9

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU- AC321 (63AA0) RECEIVER/TRANSMITTER (UHF)									
W	2.1590	2.1590	15.1129	5.3975				53.9746	78.8029
K	0.0938	0.0938	0.6566	0.2345				0.6566	1.7353
N	0.0938	0.0938	0.6566	0.2345				0.6057	1.6884
SUB	2.3466	2.3466	16.4261	5.8665				55.2409	82.2265
LRU- AC322 (63AE0) DIPLEXER									
W	0.0251	0.0251	0.1758	0.0628				0.1005	0.3893
K	0.	0.	0.	0.				0.	0.
N	0.0029	0.0029	0.0200	0.0072				0.0143	0.0472
SUB	0.0280	0.0280	0.1959	0.0700				0.1148	0.4366
LRU- AC323 (63AL0) STANDING WAVE RATIO INDICATOR									
W	0.0165	0.0165	0.1157	0.0413				0.4878	0.6779
K	0.	0.	0.	0.				0.	0.
N	0.0165	0.0165	0.1157	0.0413				0.0579	0.2480
SUB	0.0331	0.0331	0.2315	0.0827				0.5456	0.9259
CND	0.4134				1.6534				2.0668
M	0.3596	0.3596				1.9779	0.8990		3.5962
TOT/TSK	3.1806	2.7672	16.8534	6.0191	1.6534	1.9779	0.8990	55.9013	89.2520

Figure 26. Sample option 06 report

MTTR OVER SUBSYSTEMS AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	0.6001	1.5441	2.1311	0.5709	0.4140	1.4302	0.4173	5.1344	12.2419

Figure 27. Sample option 07 report

MTTR % OF TOTAL PER AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	4.902	12.613	17.408	4.663	3.382	11.683	3.408	41.941	100.000

Figure 28. Sample option 08 report

MMH OVER SUBSYSTEMS AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	1.2001	1.5441	2.1311	0.7632	0.5880	1.9452	0.7780	9.4684	18.4180

Figure 29. Sample option 09 report

MMH % OF TOTAL PER AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	6.516	8.383	11.571	4.144	3.193	10.562	4.224	51.408	100.000

Figure 30. Sample option 10 report

MMH PER 1000 FH PER AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	0.07183	0.09242	0.12755	0.04568	0.03519	0.11643	0.04656	0.56671	1.10237

Figure 31. Sample option 11 report

MAINT IND X 1000 PER AC3

	AGE F/L	TS F/L	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
TOT/TSK	0.03592	0.09242	0.12755	0.03417	0.02478	0.08560	0.02497	0.30731	0.73272

Figure 32. Sample option 12 report

Appendix A. DESCRIPTION OF INPUT DATA ELEMENTS

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KEY FIELDS - Columns 1-11 are used as the key fields, and therefore, the format is common to all the card types.

Columns	Identifier - Definition
1-2	Card Type - (1) indicates the type of data to be found on the record, and (2) indicates whether they reflect flight line, shop, or reference data CR - cross reference LF - AFSC with skill level - F/L LS - AFSC with skill level - shop MF - reliability mean values - F/L PF - P probability - F/L PS - P probability - shop SF - support equipment - F/L SS - support equipment - shop TF - task time - F/L TS - task time - shop
4-10	Equipment Identification (ID) Number - defines the equipment in a series of codes showing as follows: (4) type of weapon system; (5) major system within the weapon system; (6) functional grouping of the major system; and (7-10) a numerical breakdown by operational function (e.g., radar navigation, radio navigation, or bombing navigation), subsystem, line replaceable unit, and shop replaceable unit. These codes are determined by the user since they are configuration dependent. The codes used in the DAIS data banks are listed in Appendix A to volume one of this report. Example of data card encoding format used in DAIS R&M model for equipment specifications: Column 4 - weapon system none assigned in DAIS data banks Column 5 - major system A - avionics Column 6 - functional group A - air-ground-attack C - communications I - instruments M - miscellaneous N - navigation Z - core

Columns	Identifier - Definition
	Column 7 - operational function Column 8 - subsystem Column 9 - line replaceable unit Column 10 - shop replaceable unit none assigned in DAIS data banks
11-12	Card Sequence - the sequential number of each record for a particular subsystem or line replaceable unit within a particular card type.

FLIGHT LINE TASKS - Common to LF, PF, SF, and TF card types.

Columns	(Task Code)	Task Name - Definition
1-12		See key fields
14-18	(A)	Set up the support equipment and maintenance stands - that will be used by the technician to provide the power and the accessibility necessary to troubleshoot and repair the equipment that has failed.
20-24	(T)	Troubleshoot - the reported discrepancy to isolate the cause and to determine whether the repair action is to be a remove and replace or the repair can be accomplished on the aircraft.
26-30	(C)	Cannot Duplicate - a troubleshooting action that cannot duplicate (CND) the reported discrepancy.
32-36	(R)	Remove & Replace - once the discrepancy has been isolated to a particular LRU and a determination has been made that the repair is to be made in the shop, the faulty unit is removed and replaced by a spare.
38-42	(M)	On A/C Maintenance - if the discrepancy is minor and does not need shop repair, the equipment is maintained on the aircraft (A/C). This includes, as examples, adjustments, replacement of bulbs, knobs, fuses, and aircraft wiring problems.

Columns	(Task Code)	Task Name - Definition
44-48	(V_R)	R&R Verification - after the removal and replacement of the faulty LRU is completed, a functional check is performed to verify the operational condition of the subsystem.
50-54	(V_M)	On A/C Maintenance Verification - upon completion of any on aircraft maintenance, a functional check is performed to verify the repair and operational condition of the subsystem.

SHOP TASKS - Common to LS, SS, PS, and TS card types.

1-12		See key fields
20-24	(W)	Bench Check & Repair - in-shop bench check and complete repair of a bad LRU, including cleaning, inspection, disassembly, adjustment, part replacement, reassembly, and lubrication of the complete LRU and any minor components.
26-30	(K)	Bench Check & CND - in-shop bench check is performed, any discrepancy cannot be duplicated in the testing, the LRU is serviceable, and no repair is required.
32-36	(N)	Bench Check & NRTS - in-shop bench check or inspection shows that the LRU is not repairable this station (NRTS) because the shop is not authorized to accomplish the repair or the shop lacks the proper tools, equipment, facilities, technical skills, spare parts, time, or technical data to perform repair.
50-54	(TD)	Test Drawer Repair - in-shop repair of the test station drawer (or combination of test equipment) that is needed to test the LRU being checked.
56-60	(TS)	Test Station Repair - in-shop repair of the entire test station that is needed to test the LRU being checked.

CROSS REFERENCE FILE - Card #1

Columns	Identifier - Definition
1-9	See key field
11-12	Card sequence always - 1
14-18	Weight - in pounds of the LRU.
20-24	(WUC) work unit code used to identify each subsystem and LRU in the aircraft system (found on cards #1 and 2).
26-27	(QPA) the quantity per aircraft of a particular subsystem or LRU in the aircraft system (found on cards #1 and 2).
29-67	Equipment name or description of the operational function assigned to a subsystem or LRU.
75-76	The number of LRUs in the subsystem for which input data has been provided, and the number of SRUs per LRU on LRU input cards. Input data are provided for those LRUs requiring a significant amount of unscheduled maintenance.

CROSS REFERENCE FILE - Card #2

1-9	See key field
11-12	Card sequence always - 2
20-24	(WUC) - work unit code used to identify each subsystem and LRU in the aircraft system
26-48	(NSN) - national stock number assigned to the LRU
50-59	AN/nomenclature of the particular subsystem or LRU described on card #1
65-80	Manufacturer's Stock Number - when available

RELIABILITY MEAN VALUES - Flight Line

1-12	See key field
14-19	Mean flight hours between maintenance actions - (MFHBMA$_j$) shows the frequency of unscheduled maintenance activities required by a subsystem (j).

Columns	Identifier - Definition
21-26	H factor - is the ratio of the number of LRUs tested in the shop to the number of flight line removal actions; only the value greater than unity of the ratio is input whereby the model automatically adds the integer "1" to the given value. The resultant portion that is greater than one accounts for any mulitple LRU removals resulting from single flight line repair actions (i.e., two or more LRUs removed for one reported aircraft maintenance action). This factor is used as a multiplier of the shop probability of occurrences to obtain the actual number of shop maintenance actions eminating from flight line removal(s).

Appendix B. ERROR MESSAGES

Appendix B. ERROR MESSAGES

The following is a list of input error messages which are printed by the R&M model. The messages are described and the attributable cause or causes are listed.

_____Invalid Option

The user has selected an option outside the range of 1 to 13. The option number might not be punched properly in column 9 and 10.

Current Max Subsystems at 40

User has exceeded the program's present capacity for subsystem data input. The first card in front of the base data files contains the number of subsystems to be described. The maximum allowed is 40. The number punched in columns 1 and 2 does not fall within this range.

Preceding Subsystem Card Sequence Error

The subsystem listed just prior to this message has an error in the card sequence number, or the card type identification is invalid. The sequence number should be one in column 12 and the card type should be CR in columns 1 and 2.

_____Card where _____Card Belongs

This message appears whenever the program reads a card other than the type it expected to read. It specifies in the blanks the two card types involved. Either a card(s) is misplaced in the base data files, or one or more errors were made in punching the identification type(s), or when a card is missing.

Card Sequence Error

Some card types may allow for more than one card per equipment. In these cases, the second card must have a '2' punched in the "card sequence" field in column 12. In all cases, the first or only card for an equipment must have a '1' in this field. This error indicates a card sequencing problem that could be caused by an omission of a card 1, a mispunch in columns 1-11, or a card out of sequence.

Subsystem Equip ID Invalid

The CR cards designate the subsystem identification which consists of seven characters (columns 4-10) describing the equipment. All other card types refer to the identification as first listed in the CR card. This message declares that the subsystem identification on the card last printed did not match any which were previously entered on CR cards.

Current Max SEs Set at _____

Though the model is designed to accept several support equipments for each task, currently the maximum is set at three for the SF cards and at two for the SS cards. The user must discard the remaining support equipments for this task or the computer program must be modified to accept a higher limit.

Current Max AFSCs Set at _____

Though the model is designed to accept several AFSCs for each task, currently the maximum is set at five. The user must discard the remaining AFSCs for this task or modify the computer program to accept a higher limit.

Invalid Equipment ID

For the subsystems (equipment) with more than one card for any card type, the equipment ID on successive cards within that set must match that of the first. This message points out a violation on the preceding card.

LRU Equipment ID Invalid

Each LRU is identified by a unique seven-character designation which must be initially inputted to the program on a CR card. Any other input card type pertaining to that LRU must contain this same identification. This message indicates that either: (1) the last printed LRU card contained an identification for which the program has no previous CR card record; or (2) a mismatch exists.

Appendix C - ACRONYMS

A	inherent availability
AC	avionics communication subsystems
A/C	aircraft
AFSC	Air Force specialty code
AN	avionics navigation subsystems
CDC	Control Data Corporation
CND	cannot duplicate the discrepancy
CR	cross reference file
DAIS	digital avionics information system
FH	flight hours
F/L	flight line
FOM	figure of merit
ID	identification number of a subsystem on an LRU
KFH	1000 flight hours
LCC	life cycle cost
LCCIM	life cycle cost impact model
LF	manpower specialty - flight line file
LRU	line replaceable unit
LS	manpower specialty - shop file
MF	reliability mean values - flight line file
MFHBMA	mean flight hours between maintenance actions
MMH	maintenance man hours
MTTR	mean time to repair
NRTS	not repairable this station
NSN	national stock number
PF	P probability - flight line file
PMA	probability of a maintenance action
PS	P probability - shop file
QPA	quantity per aircraft
R&M	reliability and maintainability
R&R	remove and replace maintenance action
RTOK	retest okay
SE	support equipment
SF	support equipment - flight line file
SRU	shop replaceable unit
SS	support equipment - shop file
TF	task time - flight line file
TS	task time - shop file
WUC	work unit code